Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22362

Using crystal assemblages to interpret intermediate magma origins at Middle Sister volcano, Oregon Cascades, USA

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The Three Sisters Volcanic Complex (TSVC) is a mafic-to-silicic volcanic center in the central Oregon Cascades. Traditionally and collectively known as Klah Klahnee, the primary and most recently active stratovolcanoes of the TSVC comprise North Sister (>50 ka, primarily mafic), Middle Sister (MS; 50-14 ka, primarily mafic-intermediate), and South Sister (SS; 50-2 ka, primarily intermediate-felsic). The earliest known MS eruptions (~50-37 ka) include a range of lavas from basaltic-andesite to rhyolite, whereas later eruptions (~27-14 ka) were initially dominated by andesites, then transitioned to basaltic-andesites and dacites. While the relative importance of fractional crystallization and/or crustal melting to SS dacite genesis remains a matter of debate, the origins of MS dacites are largely unstudied. With the goal of providing a petrogenetic model for MS dacites, this work targets three eruptions that span the MS eruptive history: the oldest TSVC dacite, the dacite of Linton Creek (**dlc**, ~37 ka); the 19 ka dacite north of Separation Creek (**dsn**); and the youngest MS dacite, the dacite of Irving Glacier (**dig**, ~14 ka). Textural observations, major mineral compositions, and whole rock chemistry permit determination of co-crystallizing assemblages and their inferred origins. In all three dacites, ubiquitous orthopyroxene rims on clinopyroxene crystals and abundant resorption textures record thermal and/or compositional disequilibrium. Distinct mafic-intermediate and silicic populations of plagioclase (An_{25-45}, An_{61-80}) and orthopyroxene (Mg#54-62, Mg#66-73) in **dlc**, in addition to amphibole pseudomorphs and reacted olivine crystals, are indicative of mixing between mafic-intermediate and silicic magmatic components. Notably, amphibole-bearing silicic lavas are only affiliated with SS at the TSVC. The Ni compositions of olivine crystals found within **dlc** are also consistent with a SS basaltic andesite, but not MS basaltic andesites. These observations, paired with whole rock compositions (e.g., lower alkalis relative to SiO_2), imply that **dlc** is a SS-type lava despite it being geographically affiliated with MS. The younger units, **dsn** and **dig**, each contain discrete single populations of plagioclase (An_{35-55}) and pyroxene (largely Mg#64-70) and are compositionally similar to other MS-type dacites. Two-pyroxene and Fe-Ti oxide thermobarometry indicate high average temperatures and pressures for **dsn** (992±60°C, 10±3.7 kbar) and **dig** (985±60°C, 9±3.7 kbar).